What is claimed is:

CLAIMS

1. A fuel injector being fluidly coupled to a source of low pressure fuel and having a fuel pressure intensifier, the fuel intensifier hydraulically amplifying the fuel pressure for injection at a relatively high pressure, comprising:

a fuel injection pressure control valve for preparing fuel pressure; being in flow communication with a source of pressurized actuating fluid and selectively porting such actuating fluid to the fuel intensifier for hydraulic amplification of the fuel pressure; and

a fuel injection timing control valve for controlling the timing of a fuel injection event, the fuel injection pressure control valve and the fuel injection timing control valve being independently controllable.

2. The fuel injector of claim 1 wherein the fuel injection pressure control valve opens a window of injection opportunity and the fuel injection timing control valve controls the timing and duration of an injection event that occurs within the window of injection opportunity.

3. The fuel injector of claim 2 wherein the fuel injection pressure control valve opens a window of injection opportunity during which an actuation pressure is made available for use to intensify a fuel pressure.

4. The fuel injector of claim 2 wherein the fuel injection timing control valve controls the timing and duration of an injection event that occurs within the window of injection opportunity to define fuel injection parameters.

5. The fuel injector of claim 4 wherein the fuel injection parameters occurring within an injection event include at least one of the parameters being start of injection, end of injection, interruption of injection, timing of interruption of injection, and duration of interruption of injection.

6. The fuel injector of claim 1 wherein the fuel injection timing control valve provides for selective independent control of pilot injection, main injection and rate shaping within a single shot injection event.

7. The fuel injector of claim 1 wherein fuel injection pressure preparation and fuel injection timing control are internally determined and are decoupled.

8. The fuel injector of claim 1 wherein the fuel injection timing control valve has relatively less flow area in relation to the fuel injection pressure control valve, the lesser flow area enhancing the response time of the fuel injection timing control valve for improving the shaping of the injection event as desired.

9. The fuel injector of claim 1 wherein a full actuation pressure is available from the fuel injection pressure control valve for the duration of an injection event, thereby providing maximum injection pressure throughout the injection event without regard to shaping of the injection event as desired.

10. The fuel injector of claim 1 wherein the fuel injection pressure control valve for preparing fuel pressure is cycled opened and closed a single time during each injection event and the fuel injection timing control valve may be independently cycled opened and closed a plurality of cycles during single time during each injection event for effecting shaping of the injection event as desired.

11. A hydraulically actuated, electronically controlled unit injector having an inlet for admitting non-fuel actuating fluid to the injector and a fuel inlet for admitting a quantity of fuel at a pressure that is less than a pressure necessary to open a needle valve to cause fuel injection, an intensifier for selectively pressurizing the quantity of fuel to a pressure sufficient to open the needle valve when the intensifier is acted upon the actuating fluid, the pressurized fuel being available for control of the needle valve continuously during an injection event, the unit injector comprising:

a timing controller in fluid communication with the needle valve and with the intensifier being decoupled from actuation of the intensifier and controlling the shifting of the valve between an open and a closed disposition during an injection event by controlling a flow of pressurized fuel from the intensifier to the needle valve.

12. The hydraulically actuated, electronically controlled unit injector of claim 11 wherein the timing controller directly controls the shifting of the needle valve.

13. The hydraulically actuated, electronically controlled unit injector of claim 12 wherein the timing controller directly controls the shifting of the needle valve by selectively porting a flow of pressurized fuel to exert a force on a needle valve surface, the force acting bias the needle valve in a closed disposition.

14. The hydraulically actuated, electronically controlled unit injector of claim 11 wherein the timing controller includes an electronically actuated controller valve, the controller valve being in fluid communication with a fuel passage extending between the intensifier and the needle valve, the fuel passage conveying high pressure fuel.

15. The hydraulically actuated, electronically controlled unit injector of claim 14 wherein the controller valve is in fluid communication with a controller chamber, the controller chamber being defined in part by a needle valve surface, the timing controller porting high pressure fuel to the needle valve surface when the controller valve is in an open disposition.

16. The hydraulically actuated, electronically controlled unit injector of claim 15 wherein the controller chamber is in fluid communication with a fuel reservoir via a fuel refill passage, the controller chamber being refilled with fuel when the controller valve is in a closed disposition.

17. A hydraulically actuated, electronically controlled unit injector having an inlet for admitting non-fuel actuating fluid to the injector and a fuel inlet for admitting a quantity of fuel at a pressure that is less than a pressure necessary to open a needle valve to cause fuel injection, an intensifier for selectively pressurizing the quantity of fuel to a pressure sufficient to open the needle valve when the intensifier is acted upon the actuating fluid, the pressurized fuel being available for control of the needle valve continuously during an injection event, the unit injector comprising:

a timing controller in fluid communication with the needle valve and with the intensifier being decoupled from actuation of the intensifier and controlling the shifting of the valve between an open and a closed disposition during an injection event by controlling

a flow of pressurized fuel from the intensifier to the needle valve, the timing controller including an electronically actuated controller valve, the controller valve being in fluid communication with a fuel passage extending between the intensifier and the needle valve, the fuel passage conveying high pressure fuel, the controller chamber is in fluid communication with a fuel reservoir via a fuel refill passage, the controller chamber being refilled with fuel when the controller valve is in a closed disposition, the controller chamber being further in fluid communication with the fuel reservoir via a drain orifice, the drain orifice being open at all times.